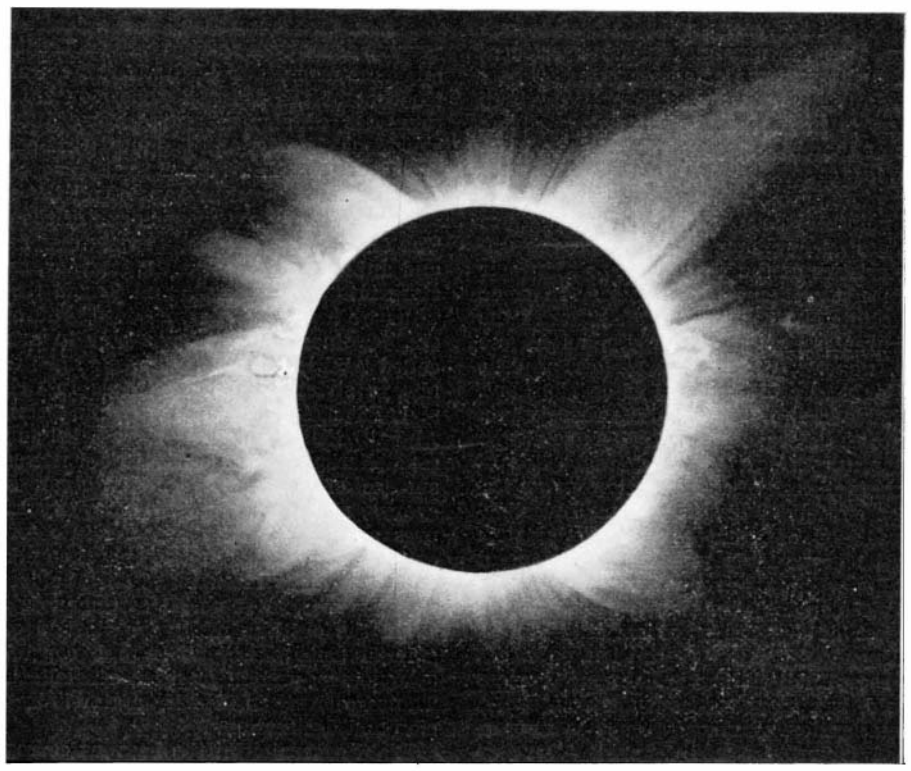
the stars were hundreds of thousands of times as remote as our sun, and it was not until 1838 that instruments sufficiently delicate were invented to determine the apex of the triangle formed by a star as the apex



THE TOTAL ECLIPSE OF AUGUST 9, 1896, PHOTOGRAPHED BY BADEN-POWELL.

and the 90,000,000-mile radius of the earth's orbit as the opposite side. The expression "parallax of a star" means the angle subtended by the semi-diameter of the earth's orbit as seen from the star. In the case of all but a few stars this is a fraction of a second of arc, too small to be measured. The greatest parallax yet observed is about 0.75 sec., being that of Alpha Centauri, our nearest neighbor so far as now known.

The study of the stars is of the most enthralling interest, and although much has been learned regarding them, the subject is boundless, and offers fascinating opportunities to the earnest student.—H. S. Manning, Jr., in Yale Scientific Monthly.

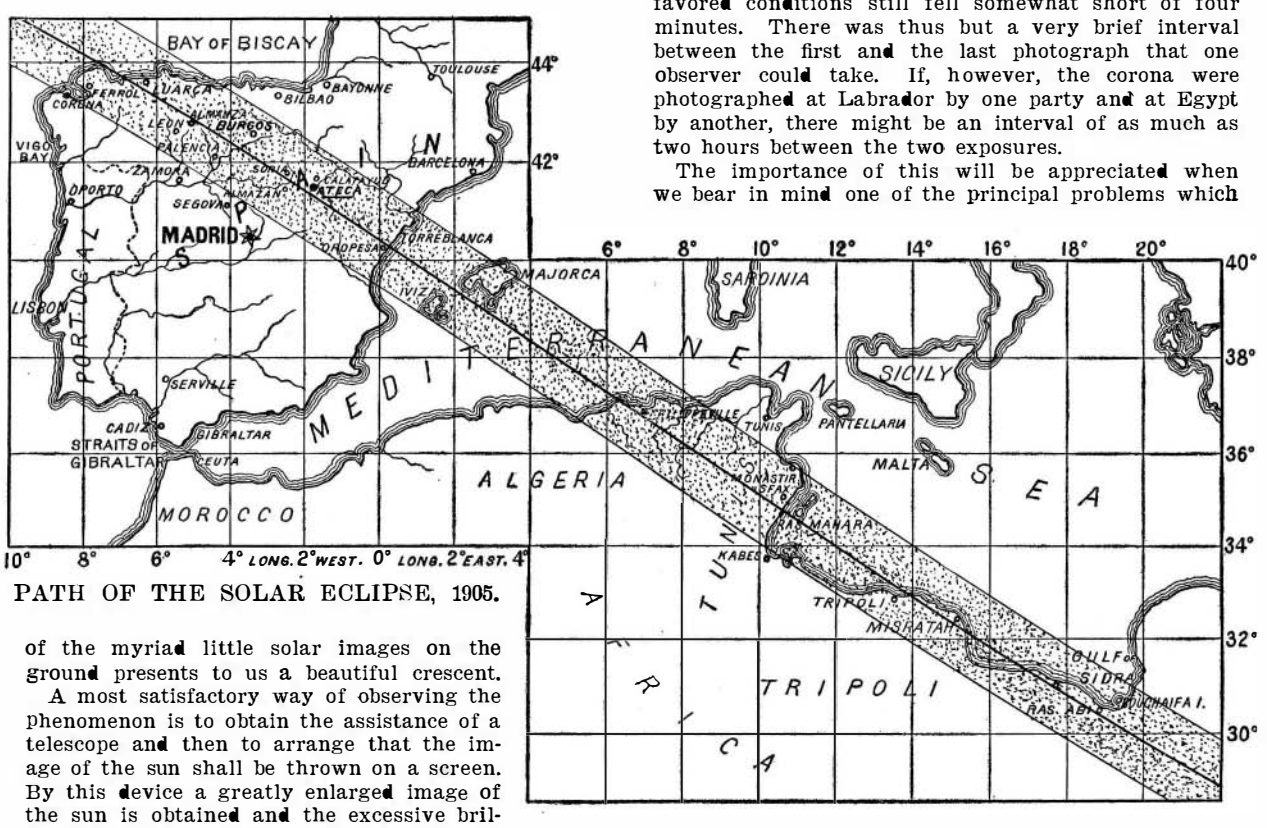
THE SOLAR ECLIPSE.

By SIR ROBERT BALL, LL.D., F.R.S.

THERE have been so many total eclipses within the recollection of most of us that the question may well be asked, why we paid any particular attention to this eclipse of August 30 among the number. The reasons are easily stated. In the first place, the duration of totality at the best stations was fairly long. The complete obscuration of the sun lasted for three minutes and fifty seconds. No doubt under a combination of favorable circumstances eclipses can and do sometimes happen in which the duration of totality, as it is called, is considerably greater. In some eclipses it has been indeed nearly twice as great. On the other hand, in many total eclipses which have been deemed worthy the attention of the astronomer, the precious seconds of totality have been barely half as many as those which was available last August.

The middle of the eclipse, that is, the occurrence of totality at noon, was observed among other places in the north of Spain. There, either at Burgos, or at a place one-third of the way from Saragossa to Madrid, or at Morella, many astronomers were stationed.

The eclipse of August was visible to some extent over the whole of Europe and the greater part of Africa. It was visible over the North Atlantic and over a great part of Canada, and was doubtless noted by many hundreds of thousands of observers. It may here be mentioned that an eclipse of this kind can be observed on a bright day when the sun is high in a manner which, though it may not be actually instructive from a scientific point of view, is certainly pleasing and picturesque. This observation is made, strange to say, not by looking up to the sun, but by looking down upon the ground. When the sun throws a shadow of a tree on the road the rays of light passing through interstices between the leaves form bright spots, which, though we may not ordinarily notice the fact, are really images of the sun. When a large part of the disk of the sun is eclipsed then the bright part is reduced to a crescent, and consequently each



PATH OF THE SOLAR ECLIPSE, 1905.

of the myriad little solar images on the ground presents to us a beautiful crescent.

A most satisfactory way of observing the phenomenon is to obtain the assistance of a telescope and then to arrange that the image of the sun shall be thrown on a screen. By this device a greatly enlarged image of the sun is obtained and the excessive brilliancy is suitably reduced.

But the characteristic phenomena which make eclipses so important are never exhibited when the phase of the eclipse is no more than a partial one. Complete extinction of the sun is necessary, or, in other words, it is necessary for the observer to take up such a position that the shadow of the moon shall pass over him as that shadow sweeps over the earth. It was with the object of getting into the track of the shadow that astronomers visited Canada, Spain, Tunis or Egypt, for the line passed through these other countries as well as through Spain. The width of the shadow track was approximately one hundred miles, but toward each end of the track the duration of the totality diminished, so that to see the eclipse under the most favorable conditions a position had to be taken as near as possible to the central line.

At just 12.41 on August 30 the shadow cone of the moon cast by the sun, after rapidly moving through space, first struck this earth. The place so honored was about Winnipeg, where the rising sun was a black globe. The shadow fell on the earth, and as a black spot about one hundred miles in diameter it commenced an eastern rush at headlong speed across our continents and oceans. In two or three minutes after its arrival it had crossed Hudson's Bay, and then, at just 11.55 o'clock in London, the shadow was launched from the coast of Labrador upon the Atlantic.

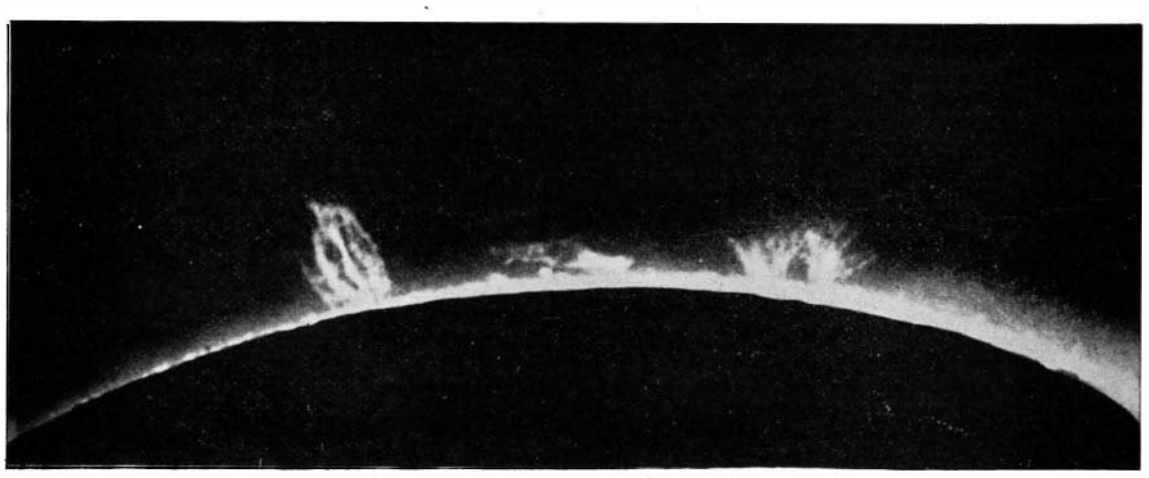
As the Greenwich clock showed 10 minutes to 1, the sun being then high in the heavens, and consequently the opportunities for observation being at their best, the Atlantic journey was over, and the shadow entered Europe near Cape Finistere. For about twenty-five minutes the course lay through Spain, and then the Mediterranean was reached. This sea was crossed till Tunis was entered about 1.40. Then Egypt was entered at 2.04. Twenty minutes later there was a crossing of the Red Sea, and then the earthly journey of the shadow drew to a close, and it ended in Arabia at 2.32, having occupied 2 hours 46 minutes in its course from Canada. At the ends of its track the duration of the totality was about two minutes, and it was nearly double as long in the central part of the track.

Thus at widely distant stations along the track, elaborate photographic appliances for depicting the appearance of the corona and for obtaining information as to its spectrum were busily engaged. This wide distribution of the observing stations made it highly probable that even if the weather were unfavorable in some places it would not be so in all places.

Thus some results were practically certain, but there was another advantage of a very different kind. The duration of the total eclipse under the most favored conditions still fell somewhat short of four minutes. There was thus but a very brief interval between the first and the last photograph that one observer could take. If, however, the corona were photographed at Labrador by one party and at Egypt by another, there might be an interval of as much as two hours between the two exposures.

The importance of this will be appreciated when we bear in mind one of the principal problems which it is hoped this eclipse may have enabled us to solve. The mysterious corona is certainly not a permanent structure. It is in constant movement, and in the intense energy of solar activity the movements occur with such rapidity that in the space of a couple of hours such large changes take place as would be quite conspicuous on the two photographs taken at such an interval. The experience of former eclipses has shown this to be the case, and it may reasonably be expected that further light will be gained by the opportunities afforded in August.

It must be remembered that the corona is never visible unless under the rare opportunity of a total eclipse. The many artificial devices by which it has been sought to exclude the direct light of the sun, and thus render the faint corona visible, have never yet succeeded. Precious, indeed, to those who would penetrate the secrets of nature were those glorious minutes in the afternoon of August 30, 1905.—The New York Tribune.



SOLAR PROMINENCES PHOTOGRAPHED BY LANGLEY DURING THE ECLIPSE OF MAY 28, 1900.

The early perfection of water-culture methods permitted a careful study of the mineral nutrient requirements in the higher plants. Pure culture methods have afforded a more accurate means of studying the needs of fungi and certain algæ. As usually installed, water cultures of the higher plants contain bacteria, so that they afford only a practical test of the requirements. The problem demands some confirmatory tests, at least, under pure culture conditions, particularly when organic compounds are employed. It is possible to grow, in a limited way, higher plants under pure culture conditions.